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STUDIES IN THE NOMENCLATURE AND CLASSIFICATION OF THE BACTERIA

V. SUBGROUPS AND GENERA OF THE BACTERIACEAE

BY

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From the Bacteriological Laboratories of Iowa State College, Ames, Iowa

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Family II. Bacteriaceae Cohn, 1872a, p. 237

Synonyms:

Bacterina Perty, 1852, p. 159
Microbacteria Cohn, 1872, p. 167
Desmobacteria Cohn, 1872, p. 173
Bacteriaceen Zopf, 1883, p. 45
Baculogenae Trevisan, 1885, p. 92
Bacteriacei Schroeter, 1886, p. 155
Bakteriaceen Hueppe, 1886, p. 142
Arthrobakteriaceen Hueppe, 1886, p. 149
Bacteriacees Cornil and Babes, 1890, p. 151
Bacillaceae Fischer, 1895, p. 139
Bacillacei Fischer, 1895, p. 139.

Cells rod-shaped, straight, or at least not spherical or spiral. Never containing sulphur granules, nor with bacterio-purpurin, many species pigmented. May or may not be motile by polar or diffuse flagella. Cells may be single or in chains. Endospores produced in some genera, not in others. A pseudoplasmodium never developed. Growth energy not secured by the oxidation of ammonia or nitrites.

The following names have been used for subdivisions of *Bacteriaceae* as here defined:

Bacterieae Trevisan, 1879, p. 136
Eubacterieae Trevisan, 1879, p. 136

Bacilleae Trêvisan, 1889, p. 12.
Eubacilleae Trevisan, 1889, p. 939
Klebsielleae Trevisan, 1889, p. 1028
Kurthieae Trevisan, 1889, p. 929
Pasteurieae Trevisan, 1889, p. 12
Bactrillei Fischer, 1895, p. 139
Bactrinei Fischer, 1895, p. 139
Bacillei Fischer, 1895, p. 139
Mycobacteriaceae Chester, 1897, p. 63
Clostridieae Fischer, 1903, p. 60
Plectridieae Fischer, 1903, p. 61
Acidobacteriaceae Jensen, 1909a, p. 344
Alkalibacteriaceae Jensen, 1909a, p. 343
Butyribacteriaceae Jensen, 1909a, p. 343
Luminobacteriaceae Jensen, 1909a, p. 303
Putribacteriaceae Jensen, 1909a, p. 343
Oxydobacteriaceae Jensen, 1909a, p. 343

De Toni and Trevisan (1889, p. 939) separated the various tribes and subtribes of their subfamily, *Baculogenae* in the following manner:

Key to Tribes and Subtribes of Baculogenae. DeToni and Trevisan

A. Bacilli and cocci naked, never with a capsule.....Tribe I. *Bacilleae*
I. Producing endospores.
1. Division longitudinal.....Subtribe 1. *Pasteurieae*
2. Division transverse.
a. Rods united into a reticulate coenobium
Subtribe 2. *Thiodictyeae*
b. Rods not united into a reticulate coenobium.
(1) Rods never spiral.....Subtribe 3. *Eubacilleae*
(2) Rods spirally bent.....Subtribe 4. *Spirilleae*
II. Producing arthrospores.....Subtribe 5. *Pacinieae*
B. Bacilli and cocci surrounded by a special membranous or gelatinous capsule.....Tribe II. *Klebsielleae*
I. Rods straight or curved, never true spirals.
Subtribe 1. *Euklebsielleae*
II. Rods spirally twisted.....Subtribe 2. *Myconostoceae*

Of these names *Pasteurieae* may be discarded because *Pasteuria* is probably a protozoan. *Thiodictyeae* includes forms

belonging to *Thiobacteria; Spirilleae, Pacineae*, and *Myconostoceae* are based upon genera now placed with the *Spirillaceae*.

Fischer (1895, p. 139) subdivided his family *Bacillacei* as follows:

Key to subfamilies of Bacillacei. Fischer

A. Non motile. Non flagellate.....I. *Bacillei*
B. Motile. With flagella
  I. Polar flagella only.
    a. A single polar flagellum.....II. *Bactriniei*
    b. A tuft of polar flagella.....III. *Bactrillei*
  II. With diffuse flagella.....IV. *Bactridiei*

Chester (1897, p. 63) grouped certain genera to constitute the family *Mycobacteriaceae*. The most important differential characters are the formation of clavate-cuneate cells, lack of endospores, and true dichotomous branching.

Later Fischer (1903, p. 60) separated his family *Bacillaceae* into three subfamilies as follows:

Key to subfamilies of Bacillaceae. Fischer

A. Spore-bearing rods unchanged in shape, cylindrical. Includes all non-sporulating forms.....Subfamily I. *Bacilleae*
B. Spore-bearing rods modified in shape.
  I. Spore-bearing rods spindle shaped.....Subfamily II. *Clostridieae*
  II. Spore-bearing rods drumstick shaped..Subfamily III. *Plectridieae*

The families proposed by Jensen (1909a, p. 344) which would be included under our definition of *Bacteriaceae* may be separated by the following key:

Key to the families of Bacteriaceae. Fischer

A. Without spores, motile or non-motile; when the former, with polar flagella, typically water forms, securing energy almost exclusively by oxidative processes.
  I. Obligate aërobes, oxidizing carbon, hydrogen or nitrogen compounds without production of noteworthy amounts of unoxidized split products.....I. *Oxydobacteriaceae*
  II. Luminous and fluorescent bacteria.....II. *Luminobacteriaceae*
B. With or without spores, either peritrichous or non-motile, not typically water forms, do not secure energy exclusively as "A."
  I. Typically not obligate anaërobic or micro-aërophilic.
    a. Usually producing acids from carbohydrates.
      I. *Acidobacteriaceae*
    b. Usually bringing about an alkaline reaction by the development of ammonia.....II. *Alkalibacteriaceae*

II. Typically anaërobic or micro-aërophilic.
a. Characteristically producing butyric acid from carbohydrates.....I. *Butyribacteriaceae*
b. Characteristically bringing about putrefactive changes in proteins.....II. *Putribacteriaceae*

An examination of the genera which have been proposed by various authors would seem to indicate that an important differential character is that of endospore production. Separation upon this basis throws all the spore-bearing rods together, a grouping which appears to be wholly natural and to represent true relationships. Of the rod-shaped organisms which do not produce spores it seems that the acid-fast bacteria related to the tubercle bacillus likewise represent a very distinct group.

For the three tribes of the *Bacteriaceae* the names *Bacilleae Bacterieae*, and *Mycobacterieae* may be used. The principal differential characters may be summarized in the following key:

Key to the Tribes of the Bacteriaceae

A. Cells not acid-fast.
I. Typically producing endospores under favorable conditions. Tribe I. *Bacilleae*
II. Not producing endospores.....Tribe II. *Bacterieae*
B. Cells acid-fast, frequently showing some tendency to branching Tribe III. *Mycobacterieae*

Tribe I. **Bacilleae** Trevisan 1889, p. 12 in part

Synonyms:
Eubacilleae Trevisan, 1889, p. 939 in part
Bactrillei Fischer, 1895, p. 139 in part
Bacillei Fischer, 1895, p. 139 in part
Bactrinei Fischer, 1895, p. 139 in part
Bacilleae Fischer, 1903, p. 60 in part
Clostrideae Fischer, 1903, p. 60 in part
Plectrideae Fischer, 1903, p. 61 in part
Alkalibacteriaceae Jensen, 1909a, p. 343 in part
Butyribacteriaceae Jensen, 1909a, p. 343 in part
Putribacteriaceae Jensen, 1909a, p. 343 in part

Cells rodshaped, never spiral or strictly filamentous, single or in

chains, usually motile by means of peritrichous flagella, producing endospores under suitable conditions of growth, usually Gram-positive.

The following pseudogeneric names of organisms within this tribe have been employed, but never have been used with a species or in a strict generic sense, and are not valid as genera.

Amylobacter Trecul, 1865, p. 432
Urobacter Trecul, 1865, p. 432
Urocephalum Trecul, 1865, p. 432
Megabacterium Billroth, 1874, p. 16
Mesobacterien Billroth, 1874, p. 16
Petalobacteria Billroth, 1874, p. 16
Streptobacteria Billroth, 1874, p. 18
Microbacterien Billroth, 1874, p. 18
Microbacteria Billroth, 1874, p. 18
Aethylbacillus Fitz, 1878, p. 48
Polybacteria Van Tieghem, 1884
Streptobacterium Billet, 1890, p. 23
Streptobacillus Preisz? Migula, 1900, p. 374
Bacterius Kendall, 1902, p. 484
Bactrillus Kendall, 1902, p. 484
Bactrinius Kendall, 1902, p. 484
Microbacterium (Billroth) Smith, 1905, p. 174
Plennobakterium Gonnermann, 1907, p. 887

The following generic names have been used, but the species are not identifiable with any degree of certainty:

Bactrella Morren, 1830, p. 1
Sporonema Perty, 1852, p. 160

Subgeneric names:

Streptobacter Schroeter, 1886, p. 158
Eu-Cornilia Trevisan, 1889, p. 998
Pleurospora Trevisan, 1889, p. 1002

The following generic name is invalid because earlier used as the generic name of a distinct group of plants.

Bactridium Fischer, 1895, p. 139
not *Bactridium* Kunze
not *Bactridium* Salisb.

Generic names which are not invalid for any of the preceding reasons are the following:

Serratia Bizio, 1823, p. 288
Bacterium Ehrenberg, 1828
Bacteridium Davaine, 1868, p. 21
Bacillus Cohn, 1872b, p. 174
Urobacillus Miquel, 1879, p. 517
Clostridium Prazmowski, 1880, p. 23
Pollendera Trevisan, 1884, p. 943
Zopfiella Trevisan, 1885, p. 93
Cornilia Trevisan, 1889, p. 21
Eubacillus Dangeard, 1891, p. 151
Granulobacter Beijerinck, 1894, p. 3
Bactrillum Fischer, 1895, p. 139
Bactrinium Fischer, 1895, p. 139
Clostrillum Fischer, 1895, p. 139
Clostrinium Fischer, 1895, p. 139
Diplectridium Fischer, 1895, p. 140
Paracloster Fischer, 1895, p. 141
Paraplectrum Fischer, 1895, p. 141
Plectridium Fischer, 1895, p. 147
Astasia Meyer, 1898, p. 49
Fenobacter Beijerinck, 1900, p. 200
Aplanobacter E. F. Smith, 1905, p. 171
Semiclostridium Maassen, 1905, p. 5
Myxobacillus Gonnermann, 1907, p. 877
Botulobacillus Jensen, 1909a, p. 343
Butyribacillus Jensen, 1909a, p. 343
Cellulobacillus Jensen, 1909a, p. 343
Putyribacillus Jensen, 1909a, p. 343
Pectobacillus Jensen, 1909a, p. 343
Metabacterium Chatton and Perard, 1913, p. 1232

The genus *Eubacillus* Dangeard is believed by Migula (1897,

p. 94) to include organisms which are not true bacteria. The type species, *Eubacillus multisporus*, has chlorophyll, is filamentous, and produces many endospores in a filament. Until this organism can again be identified and studied more closely its position is doubtful, and it should perhaps be excluded from present consideration.

The genera of the tribe *Bacilleae* may be differentiated by the following key:

Key to the genera of Bacilleae

A. Usually a single endospore formed within each cell.
  I. Aërobic, usually Gram-positive, as a rule liquefying gelatin, spores usually not distorting rods when formed.....Genus 1. *Bacillus*
  II. Anaërobic or microaërophilic usually.
    a. Spores produced at extreme tip of cells, forming typical drumsticks.....Genus 2. *Plectridium*
    b. Spores not produced at extreme tip of cells, at least not forming drumsticks. Cells usually somewhat swollen when spores are formed.....Genus 3. *Clostridium*
B. Usually a number of spores develop within a swollen cell.
  Genus 4. *Metabacterium*

Genus 1. **Bacillus** Cohn, 1872b, p. 174

Synonyms:

Bactrella? Morren, 1830, p. 354
Metallacter? Perty, 1852, p. 180
Bacteridium Davaine, 1868, p. 21
Urobacillus Miquel, 1879, p. 517
Pollendera Trevisan, 1884, p. 943
Dispora? Kern, 1882, p. 135
Zopfiella Trevisan, 1885, p. 93
Cornilia Trevisan, 1889, p. 21 in part
Bacterium Migula, 1894, p. 237 in part
  not *Bacterium* Ehrenberg, 1828
  not *Bacterium* Cohn, 1872b, p. 167
Bactrinium Fischer, 1895, p. 139
Bactrillum Fischer, 1895, p. 139
Endobacterium Lehmann and Neumann, 1896, p. 103
Astasia Meyer, 1898, p. 49
Saccharobacter? Beijerinck, 1900, p. 200

Fenobacter Beijerinck, 1900, p. 200
Aplanobacter E. F. Smith, 1905, p. 171
Semiclostridium Maassen, 1905, p. 5
Myxobacillus Gonnermann, 1907, p. 877
Plennobacterium Gonnermann, 1907, p. 887
Serratia Vuillemin, 1913, p. 521
not *Serratia* Bizio 1823

Cells rod-shaped, straight or at least never spiral, motile by diffuse flagella or non-motile. Endospores produced under favorable conditions, not usually distorting the cell, usually Gram-positive. Growth usually good on laboratory media; commonly liquefying gelatin. Aërobic or facultative.

There has been much diversity in the literature as to the use of the generic name *Bacillus*. It was first used by Cohn (1872, p. 174) to include three species of rod-shaped organisms, *Bacillus subtilis*, *B. ulna*, and *B. anthracis*. He characterized the genus as including those rod-shaped organisms that grow in filaments. Later he discussed at length spore production in *B. subtilis*, and gave the first accurate description of endospores. Various authors accepting either *B. subtilis* or *B. anthracis* as the type of the genus have emphasized different characters so that there are current in literature at least six conceptions of the genus. These are as follows:

1. Bacillus. Rod-shaped organisms growing in filaments or in chains. Spore production, flagella distribution and motility not emphasized or regarded as secondary. Among the authors who have made use of this definition are Cohn (1872 and 1875), Magnin (1878), Winter (1879), Luerssen (1879), Van Tieghem (1884), Grove (1884), Flügge (1886), and Schroeter (1886).

2. Bacillus. Rod-shaped organisms producing endospores. (Some authors recognize other spore-bearing genera in addition to *Bacillus*.) The following have used this definition; De Bary (1884 and 1887), Zopf (1885), Hueppe (1885), Cornil and Babes (1885 and 1890), De Toni and Trevisan (1889), Ludwig (1892), Freudenreich (1894), Lehmann and Neumann (1896), Chester (1897), Flügge (1908), Jensen (1909), Heim (1911), Löhnis (1913).

3. Bacillus. Rods motile by means of peritrichous flagella, spores may or may not be produced. The following authors have recognized this definition; Migula (1894, 1895, 1897, 1900, 1904), Chester (1901), Kendall (1901), A. J. Smith (1902), E. F. Smith (1905), Ellis (1909), Frost (1911), and Schneider (1912).

4. Bacillus. Rods, non-motile, producing endospores. Fischer (1895), Lotsy (1907).

5. Bacillus. Any rod-shaped organism. Baumgarten (1890), Sternberg (1892), Mace (1897), Hewlett (1898), and Matzuschita (1902).

6. Bacillus. Any motile rod. Conn (1909).

Vuillemin (1913) has claimed that the name Bacillus has been so vulgarized by the bacteriologist because of the number of definitions that it should be abandoned as a generic designation. It is, of course, true that bacillus is used as a common designation of all rod-shaped bacteria, but this should not invalidate the use of this term as a generic name any more than the use of *Chrysanthemum* or *Aster* as genera by botanists is interfered with by the common names chrysanthemum and aster.

In some form or with some definition the genus *Bacillus* should be retained. The type practically always accepted is *B. subtilis*. The definition of Fischer should therefore be abandoned as including only non-motile forms. He would exclude from the genus its first described species. The original description of Cohn is scarcely sufficient, for much stress was laid upon cell grouping and length of cell and not upon other characters. The use of Migula's diagnosis, including in the genus all rods with peritrichous flagella, is the cause of great confusion. It brings into the genus such discordant types as the hay bacillus and the typhoid bacillus while it excludes the anthrax bacillus so closely related to the hay bacillus. Migula's definition should be abandoned as not based upon natural affinities. The definitions which would include all rods in the genus *Bacillus* have the merit of simplicity. When, however, organisms so diverse in characteristics as the tubercle bacillus, the typhoid bacillus, the tetanus bacillus, and the anthrax bacillus are all included in one genus the simplicity is more apparent than real. The existence

of such diverse forms has led most recent authors to divide bacteria into well marked groups. It is the opinion of the author that the larger of these groups should be recognized as genera. The term *Bacillus* should therefore be restricted, and it would seem that it should be defined more nearly in the terms of De Bary, Zopf, Hueppe, etc., who emphasized the importance of spore production as a diagnostic character.

The objection may be raised that a definition of *Bacillus* as a genus made up of endosporous rods would exclude forms which have lost the power of spore formation but are in other respects closely related. It is evidently impracticable to base generic diagnoses upon a single character. Even though an organism be a variant in one or even more characters, the other resemblances would be sufficient to include the organism in question in the correct genus. Illustrations of this fact may be taken from higher plants. The Lombardy poplar is always classified in the genus *Populus*. It never produces fruit, and it persists solely as the result of vegetative reproduction; yet the genus *Populus* is based in part upon certain fruit characters. The other characters are so evidently poplar-like, however, that we do not question the correctness of the assignment of this species to the genus *Populus*.

The genus *Bacillus* is a relatively large one, and shows some degree of differentiation among the species. It may to advantage be divided into subgenera.

The following key differentiates the subgenera on the basis of their most striking characteristics:

Key to the subgenera of Bacillus

A. Spore not barrel-shaped in longitudinal section and not star-shaped in cross section.
   I. Motile by means of peritrichous flagella..Subgenus 1. *Eu-Bacillus*
   II. Non-motile.....Subgenus 2. *Bacteridium*
B. Spore barrel-shaped in longitudinal section, longitudinal striations evident. Subgenus 3. *Astasia*

Subgenus 1. **Eu-Bacillus**

Synonyms:

Urobacillus Miquel, 1879, p. 517

Zopfiella Trevisan, 1885, p. 93

Bactrinium Fischer, 1895, p. 139
Bactrillum Fischer, 1895, p. 139
Fenobacter Beijerinck, 1900, p. 200
Myxobacillus Gonnermann, 1907, p. 877
Serratia Vuillemin, 1913, p. 521
not *Serratia* Bizio, 1823

Motile, usually by means of peritrichous flagella. Spores not barrel-shaped, without longitudinal ridges. Other characters those of the genus.

The type species of the subgenus is *Bacillus subtilis* Cohn.

Subgenus 2. **Bacteridium** Davaine, 1868, p. 21

Synonyms:
Pollendera Trevisan, 1884
Bacterium Migula, 1894, p. 237
not *Bacterium* Ehrenberg, 1828
not *Bacterium* Cohn, 1872b, p. 167
Bacillus Fischer, 1895, p. 139
not *Bacillus* Cohn, 1872, p. 174
Aplanobacter E. F. Smith, 1905, p. 171

Non-motile, without flagella. Spores not barrel-shaped, without longitudinal ridges. Other characters those of the genus.

The type species is *Bacillus* (*Bacteridium*) *anthracis* Cohn.

The name *Bacteridium*, according to E. F. Smith, is invalid because of the previous existence of the genus *Bactridium*, Kunze, 1817. Whether or not this invalidates *Bacteridium* Davaine depends upon the interpretation of Article 57 and Recommendation XXXI of the botanical code. The former states that when the difference between two names, especially two generic names lies in the termination these names are to be regarded as distinct even though differing by one letter only. The latter reads:

Many names differ by a single letter without risk of confusion. In cases where a close approach to identity is a source of error (ex. *Astrostemma* and *Asterostemma* in one and the same family, *Asclepiadaceae*)

only one, the older, of the names should be kept in accordance with Article 51, 4°."

This last article reads:

Every one should refuse to admit a name in the following cases:
4. When the group it designates embraces elements altogether incoherent, or when it becomes a permanent source of confusion or error.

It would seem that there is ample justification in the code for the recognition of *Bacteridium* Davaine.

Subgenus 3. **Astasia** Meyer, 1898, p. 49

Motile rods, spores ovoid with longitudinal striae, star-shaped in cross section.

The type species is *Bacillus* (*Astasia*) *asterospora* Meyer.

Genus 2. **Plectridium** Fischer, 1895, p. 147

Synonyms:

Paraplectrum Fischer, 1895, p. 139
Plectrinium Fischer, 1895, p. 139
Plectrillum Fischer, 1895, p. 139
Diplectridium Fischer, 1895, p. 140
Putribacillus Jensen, 1909a, p. 343 in part
Pectobacillus Jensen, 1909a, p. 343 in part

Cells rod-shaped, straight or at least never spiral, motile by diffuse flagella or non-motile. Endospores produced under favorable conditions, causing an enlargement of one tip of the cell, giving rise to a drumstick appearance. Usually Gram-positive. Anaërobic or microaërophilic.

The type species is *Plectridium tetani* (Nicolaier) Fischer.

Genus 3. **Clostridium** Prazmowski, 1880, p. 23

Synonyms:

Amylobacter Trecul, 1865, p. 435
Cornilia Trevisan, 1889, in part

Granulobacter Beijerinck, 1893, p. 7
Clostrillum Fischer, 1895, p. 139
Clostrinium Fischer, 1895, p. 139
Paracloster Fischer, 1895, p. 140
Semiclostridium Maassen, 1905, p. 5
Botulobacillus Jensen, 1909a, p. 343
Butyribacillus Jensen, 1909a, p. 342
Cellulobacillus Jensen, 1909a, p. 343
Putribacillus Jensen, 1909a, p. 343 in part

Cells rod-shaped, straight or at least never spiral. Frequently showing granules. Endospores usually produced in cells showing some enlargement; usually the cells become spindle-shaped. Anaërobic or microaërophilic. Usually Gram-positive.

The type species is *Clostridium butyricum* Prazmowski.

Genus 4. **Metabacterium** Chatton and Perard, 1913, p. 1232

Rod-shaped, known only in the sporulating state, from the caecum of a guinea pig. Sporogenous cell becomes ellipsoidal with one to eight endospores within a single cell.

The type species is *Metabacterium polyspora* Chatton and Perard.

The organism has not been cultivated. The diagnosis makes it evident that the organism is scarcely sufficiently known to make accurate diagnosis possible. It has been urged by Vuillemin (1913) as a *genus conservandum.*

Tribe II. **Bacterieae** Trevisan, 1879, p. 136 emended

Synonyms:
Klebsielleae Trevisan, 1889, p. 1028
Acidobacteriaceae Jensen, 1909a, p. 303 in part
Luminibacteriaceae Jensen, 1909a, p. 344

Cells rod-shaped, never spiral nor strictly filamentous; single or in chains, motile or non-motile, never producing endospores, either Gram-positive or -negative.

The following pseudogeneric names or words not used strictly in a generic sense have been applied to organisms of this subfamily.

Mycothrix Itzigsohn, 1867
Microsporon Klebs, 1871
Ascobacteria Billroth, 1874, p. [illegible]
Coccobacteria Billroth, 1874, p. 1
Diplobacteria Billroth, 1874, p. 16
Gliabacteria Billroth, 1874, p. 5
Megabacteria Billroth, 1874, p. 16
Mesobacteria Billroth, 1874, p. 16
Microbacteria Billroth, 1874, p. 16
Monobacteria Billroth, 1874, p. 16
Petalobacteria Billroth, 1874, p. 16
Polybacteria Van Tieghem, 1884, p. 1114
Punctula Van Tieghem, 1884, p. 1114
Diplobacterium Hasse, 1887, p. 347
Gliscrobacterium Malerba and Sanna Salaris, 1888, p. 486
Photobacter Beijerinck

The following names have been designated as genera, but without species.

Arthrobacterium De Bary, 1884
Arthrobacter Fischer, 1895, p. 141
Arthrobactridium Fischer, 1895, p. 140
Arthrobactrillum Fischer, 1895, p. 139
Arthrobactrinium Fischer, 1895, p. 139
Thermobacterium Fuhrmann, 1906, p. 8

The following generic names are old algal or protozoan genera to which bacteria were occasionally ascribed.

Monas Mueller, 1773, p. 3
Gloeotila Kuetzing, 1843, p. 245
Mycothamnion Kuetzing, 1843, p. 126

The following are aberrant spellings of generic names.

Kokkobacillus Biedert, 1885, p. 439
Arthrobakterium Hueppe, 1886, p. 145
Glischrobacterium Rothmann, 1904, p. 491
Bakterium of many German authors

The following are subgenera:

Eu-Klebsiella Trevisan, 1889, p. 1028
Eu-Mantegazzaea Trevisan, 1889, p. 942
Eu-Pacinia Trevisan, 1889, p. 23
Eupseudomonas Migula, 1895, p. 29

The following names are not invalid for any of the preceding reasons.

Mycoderma Persoon, 1822, p. 96
Serratia Bizio, 1823
Zaogalactina Sette, 1824, p. 51
Bacterium Ehrenberg, 1828, p. 8
Ulvina Kuetzing, 1837, p. 26
Umbina Naegeli, 1849
Zoogloea Cohn, 1854, p. 123
Schinzia Frank, 1879, p. 376
not *Schinzia* Dennstatt, 1818
not *Schinzia* Naegeli, 1842, p. 279
Mantegazzaea Trevisan, 1879, p. 146
Cromobacterium Bergonzini, 1881, p. 153
Tyrothrix Duclaux, 1879, p. 79
Actinobacter Duclaux, 1882, p. 110
Dispora Kern, 1882, p. 135
Bacteriopsis Trevisan, 1885, p. 103
Coccobacillus Leube, 1885
Klebsiella Trevisan, 1885, p. 94
Kurthia Trevisan, 1885, p. 92
Octopsis Trevisan, 1885, p. 102
Proteus Hauser, 1885, p. 100
Helicobacterium Miller, 1886, p. 117
Phytomyxa Schroeter, 1886, p. 134
Diplobacillus Weichselbaum, 1887, p. 212
Pasteurella Trevisan, 1887, p. 94
Zygobacterium Maggio, 1887, p. 318
Cladochytrium Vuillemin 1888, p. 121
Coccobacterium Rivolta, 1888.
Diccoccia Trevisan 1889, p. 26

Photobacterium Beijerinck 1889, p. 401
Pneumobacillus Arloing, 1889, p. 428
Rhizobium Frank, 1889, p. 338
Winogradskya Trevisan, 1889, p. 12
Ascobacterium Babes, 1890, p. 155
Nevskia Famintzin, 1891, p. 481
Pseudomonas Migula, 1894, p. 237
Halibacterium Fischer, 1894, p. 22
Rhizobacterium Kirchner 1895, p. 213
Oenobacillus Forti, 1896, fasc. 1
Corynebacterium Lehmann and Neumann, 1896, p. 350
Astrobacter Jennings, 1896, p. 312
Aërobacter Beijerinck, 1900, p. 198
Pseudorhizobium Hartleb, 1900, p. 887
Azotobacter Beijerinck, 1901, p. 561
Corynethrix Bongert 1901, p. 449
Lactobacillus Beijerinck 1901b, p. 214
Lactobacter Beijerinck 1901b, p. 200
Brachybacterium Troili-Peterson, 1903, p. 138
Thiobacillus Beijerinck, 1904, p. 598
Acetobacter Fuhrmann, 1905, p. 8
Erythrobacillus Fortineau, 1905, p. 104
Pyobacillus Koppanyi, 1907, p. 429
Acetimonas Jensen, 1909a, p. 312
Carboxydomonas Jensen, 1909a, p. 311
Caseobacterium Jensen, 1909a, p. 311
Corynemonas Jensen, 1909a, p. 344
Denitrobacterium Jensen, 1909a, p. 314
Denitromonas Jensen, 1909a, p. 314
Erysipelothrix Rosenbach, 1909, p. 367
Liquidobacterium Jensen, 1909a, p. 337
Liquidomonas Jensen, 1909a, p. 332
Methanomonas Jensen, 1909a, p. 311
Propionibacterium Jensen, 1909a, p. 337
Rhizomonas Jensen, 1909a, p. 334
Thermobacillus Jensen, 1909a, p. 339
Asterococcus Borrel, etc., 1910, p. 179

Fusiformis Hoelling, 1910, p. 240
Thermobacterium Lindner
Microbacillus Sabouraud
Photobacter Beijerinck
Ascobacillus Unna and Tommasoli, p. 60

Among this list of generic names the following are based upon species insufficiently described, and are disregarded here: *Actinobacter, Astrobacter, Coccobacterium, Helicobacterium, Winogradskya, Zoogloea, Zygobacterium.*

The following have been termed physiological genera and have usually been regarded as invalid: *Halibacterium, Photobacter, Photobacterium, Lactobacter.*

The following generic names have not been included for other reasons: *Ascobacillus, Ascobacterium, Carboxydomonas, Oenobacillus, Photobacterium, Methanomonas, Microbacillus.*

The following key gives the principal differential characters of the subtribes which are proposed:

Key to the subtribes of the Bacterieae

A. Cells usually fusiform.....Subtribe I. *Fusiforminae*
B. Cells not fusiform.
I. Requiring serum or hemoglobin for development. Obligate parasites. Gram-negative. Non-motile..Subtribe II. *Hemophilinae*
II. Not requiring serum, or at least hemoglobin for development. Gram-negative or positive. Motile or non-motile.
a. Obligate aërobes, securing growth energy by oxidation of carbonaceous compounds, as carbohydrates, alcohols, etc.....Subtribe III. *Rhizobiinae*
b. Not obligate aërobes, not securing growth energy by oxidation of carbonaceous compounds, Subtribe IV. *Bacteriinae.*

Subtribe I. **Fusiforminae** Subtrib. nov.

This tribe has a single genus, *Fusiformis* Hoelling.

Genus I. **Fusiformis** Hoelling 1910, p. 240

Synonym:
Mantegazzaea Vuillemin 1913, p. 521
not *Mantegazzaea* Trevisan 1879, p. 137

Obligate parasites. Cells usually elongate and fusiform. Gram-negative? Anaërobic. Non-motile. No spores. In some respects approaching the spirochetes in morphology.

The type species is *Fusiformis termitidis* Hoelling (possibly *F. dentium*).

Vuillemin (1913, p. 521) has proposed that the name *Mantegazzaea* Trevisan be retained as one of the "formogenera conservanda," with the fusiform bacillus of the medical writers as the type species. The name as used by Trevisan was used principally for certain of the sulphur bacteria, and not for forms related to this type.

Subtribe II. **Hemophilinae** Subtrib. nov.

Strict parasites, requiring hemoglobin or at least serum for their growth in media. Gram-negative. Non-motile. Cells may be pleomorphic. Usually very small. No spores.

The two genera may be differentiated by the following key:

Key to the genera of Hemophilinae

A. Requiring serum for growth. Cells almost ultra-microscopic. Stain best by Giemsa. Involution forms characteristic.....Genus 1. *Asterococcus*

B. Requiring hemoglobin for growth. Stain readily with ordinary aniline dyes. Involution forms infrequent.....Genus 2. *Hemophilus*

Genus I. **Asterococcus** Borrel, *et al.*, 1910, p. 179

Pleomorphic cells, appearing at different stages of development as isolated cocci or as chains of cocci, as rods and as filaments variously branched and swollen. Very minute, almost ultramicroscopic. Non-motile. No spores. Stains with difficulty, best with Giemsa stain. Growth in cultures only in presence of serum or of hemoglobin.

The type species is *Asterococcus mycoides* Borrel, *et al.*, of bovine pleuropneumonia.

Genus 2. **Hemophilus.** Committee

Rod-shaped cells, minute, non-motile, without spores, strict parasites, growing best or only in presence of hemoglobin. Gram-negative, stain readily with aniline dyes.

The type species is *Hemophilus influenzae*, (——) comb. nov. the cause of influenza.

Subtribe III. **Rhizobiinae** Subtrib. nov.

Rod-shaped organisms, securing their growth energy by the oxidation of carbonaceous compounds, as carbohydrates, alcohol, etc. Do not require serum, etc. Not parasitic in animals.

The following key gives the principal differential characters of the genera:

Key to the genera of Rhizobiinae

A. Not fixing atmospheric nitrogen; securing growth energy usually by the oxidation of ethyl alcohol to acetic acid.....Genus 1. *Mycoderma*

B. Capable of fixing appreciable amounts of atmospheric nitrogen. Grow well on nitrogen-free media.

a. Small motile rods, with abundant involution forms, frequently living in root nodules of the higher plants (legumes)...Genus 2. *Rhizobium*

b. Not symbiotic. Cells larger, plump, almost spherical in some cases. Genus 3. *Azotobacter*

Genus I. **Mycoderma** Persoon, 1822, p. 96 emended

Synonyms:

Ulvina Kuetzing, 1837, p. 26
Umbina Naegeli, 1849
Bacteriopsis? Trevisan, 1885, p. 103
Acetobacter Fuhrmann, 1905, p. 8
Acetimonas Jensen, 1909a, p. 312

Cells rod-shaped, frequently in chains, non-motile usually, without spores. Obligate aërobes, growing usually as a film on the surface of alcoholic solutions, transforming the alcohol to acetic acid. Involution forms often developed and quite characteristic.

The type species is *Mycoderma aceti* Thompson?

There is some doubt as to the appropriateness of *Mycoderma* as the name of this genus. It is possible that it should be reserved for the yeasts.

Genus 2. **Rhizobium** Frank, 1889, p. 338

Synonyms:

Cladochytrium Vuillemin, 1888, p. 121
Phytomyxa Schroeter, 1886, p. 134
Schinzia Denstatt, 1818, in part
Rhizobacterium Kirchner, 1895, p. 213
Pseudorhizobium Hartleb, 1900, p. 887
Rhizomonas Jensen, 1909a, p. 334

Rod-shaped cells, motile when young by means of polar flagella, obligate aërobes, fixing atmospheric nitrogen when grown in a nitrogen-free medium containing suitable carbohydrates, involution forms abundant and characteristic, usually growing in the nodules of the roots of leguminous plants.

The type species is *Rhizobium leguminosarum* Frank.

The name of this genus has been a source of confusion. The organism of leguminous nodules was placed in the mold genus *Schinzia* by Frank as *Schinzia leguminosarum.* Schroeter (1886, p. 134) concluded the organism to be one of the slime molds and created the genus *Phytomyxa*, including it in the order *Phytomyxini* among the *Myxomycetes.* He based his conclusions as to the position of this organism among the slime molds upon the work of Prilleaux (1879, p. 98). Beijerinck (1888, p. 758) named the organism *Bacillus radicicola.* Frank (1889, p. 338) renamed the organism *Rhizobium leguminosarum.* The fact that Schroeter included this genus incorrectly among the slime molds does not invalidate the name. The Committee on Classification of Bacteria, of the Society of American Bacteriologists, however, has recommended the use of the generic name *Rhizobium* as better known and probably resulting in less confusion than the use of *Phytomyxa.*

Genus 3. **Azotobacter** Beijerinck, 1901d, p. 561

Relatively large rods, or even cocci, sometimes almost yeast-like in appearance, dependent primarily for growth energy upon the oxidation of carbohydrates; obligate aërobes, usually growing

in a film upon the surface of the culture medium. Capable of fixing atmospheric nitrogen in considerable amounts when grown in solutions deficient in combined nitrogen. Motile or non-motile, if the latter, with polar flagella.

The type species is *Azotobacter chroöcoccum* Beijerinck.

It is possible that the demonstration of endospore production by Löhnis and his co-workers will require the removal of this genus to the *Bacilleae*.

Subtribe IV. **Bacteriinae** Subtrib. nov.

Cells not fusiform, rod shaped; not hemoglobinophilic; aërobic, facultative, or microaërophilic; not securing growth energy exclusively by the oxidation of carbonaceous compounds. Spores never formed. Motile or non-motile.

The following key to the genera recognized gives the most important differential characters:

Key to genera of Bacteriinae

A. Producing usually a yellowish or greenish or fluorescent pigment, usually Gram-negative, motile by means of polar flagella, or non-motile. Genus 1. *Pseudomonas*

B. When pigmented not greenish or fluorescent, when motile with peritrichous flagella.

1. Cells typically pigmented, chromoparous.
   a. Producing red or pink pigment.....Genus 2. *Serratia*
   b. Producing a violet pigment.....Genus 3. *Chromobacterium*
2. Cells not typically definitely pigmented, or at least not red or violet.
   a. Cells typically Gram-negative.
      (1) Non-motile, showing bipolar staining commonly. Never produce gas from carbohydrates. Power of acid production low.....Genus 4. *Pasteurella*
      (2) Not showing bipolar staining.
         (a) Not producing honey-like growth on potato, branching forms uncommon.
            x. Gelatin not liquefied or liquefied very slowly. Motile or non-motile.....Genus 5. *Bacterium*
            xx. Gelatin liquefied quickly. Motile. Genus 6. *Proteus*
         (b) Producing a honey-like growth on potato. Branched cells not uncommon. Genus 7. *Pfeifferella*

b. Cells typically Gram-positive. All non-motile.
(1) Usually microaërophilic. Not typically growing well on the surface of laboratory media. Without metachromatic granules.
(a) Non-pathogenic lactic acid bacilli.
Genus 8. *Lactobacillus*
(b) Pathogenic, slender, small rods, not lactic acid formers.....Genus 9. *Erysipelothrix*
(2) Aërobic rods, frequently showing metachromatic granules or irregular staining...Genus 10. *Corynebacterium*

Genus 1. **Pseudomonas** Migula, 1894, p. 237, emended

Synonyms:

Bacterium Ehrenberg emended Cohn, 1872, p. 167
Bactrillum Fischer, 1895, p. 139
Arthrobactrinium Fischer, 1895, p. 139
Arthrobactrillum Fischer, 1895, p. 139
Bactrinius Kendall, 1902, p. 484
Bactrillius Kendall, 1902, p. 484
Denitromonas Jensen, 1909, p. 314
Liquidomonas Jensen, 1909, p. 332

Rod-shaped bacteria, never spiral, usually motile by means of polar flagella or rarely non-motile. Aërobic and facultative. Frequently liquefying gelatin. Without spores. Gram stain variable. Usually producing a water-soluble pigment which diffuses through the medium as a green, blue, purple, or brown or in some cases a yellow pigment. Fermentation of carbohydrates usually not active.

The type species is *Pseudomonas aeruginosa* (Schroeter) Frost?

It is difficult to determine whether the generic names *Pseudomonas* or *Bacterium* should be used here. There is evidence that the latter is historically valid for this genus, but it has not generally been so accepted. The generic name *Bacterium* has been used in some seven different senses.

1. Bacterium. The conception held before the work of Cohn, 1872. Relatively rigid cells or chains of cells, not flexible, motile, motion usually oscillatory. The name was used in this sense by Ehrenberg (1828), Dujardin (1841), Perty (1852) and Davaine (1868).

2. Bacterium. Short cylindric or elliptic cells, never in chains or filaments, showing stages of motility and non-motility. Cohn (1872b, 1875), Dallinger and Drysdale (1875), Magnin (1878), Winter (1879), Luerssen (1879), Grove (1884), Van Tieghem (1884), Flügge (1886).

3. Bacterium. Rod-shaped organisms which do not produce endospores. Motility and cell groupings not emphasized. The genus is contrasted with *Bacillus* in these characters. Zopf (1885), Hueppe (1885), Schroeter (1886), De Toni and Trevisan (1889), Ludwig (1892), Freudenrich (1894), Lehmann and Neumann (1896), Löhnis (1913).

4. Bacterium. Not used as a generic name, all rod-shaped organisms being placed in *Bacillus* or other genera. Baumgarten (1890), Sternberg (1892), Fischer (1897), Matzuschita (1902), Schneider (1912).

5. Bacterium. Non-motile rod-shaped organisms. Migula (1895, 1897, 1904), Chester (1901), Smith (1902), Kendall (1902), Ellis (1909), Heim (1911).

6. Bacterium. Polar flagellate organisms of the type of the fluorescent bacilli. E. F. Smith (1906), Vuillemin (1913).

7. Bacterium. Organisms belonging to the colon-typhoid group. Orla Jensen (1909a).

This diversity in definition of this genus has led to considerable confusion in literature. It would seem logical to select one of the species early named *Bacterium*, and designate it as the generic type. However, of the species named before Cohn's descriptions in 1872 there does not seem to be a single one which can be identified with certainty.

It might seem best to select some organism early named *Bacterium* as the type and so word the generic diagnosis as to include this form and the related species.

E. F. Smith has attempted to identify the *Bacterium termo* of Cohn, evidently intended by this author to constitute the type of the genus. He states

> His (Cohn's) *Bacterium termo* was a small schizomycetous organism capable of growing freely in Cohn's nutrient solution, containing acid potassium phosphate and ammonium tartrate. It produced thereon

short rods (single, in pairs or fours, joined end to end) and roundish lobed white zoogloeae, together with a *greenish* fluorescence. It did not appear in boiled fluids, i.e. was destitute of endospores (Cohn) and the motile rods were killed by short exposure to 58°C. (Schröeter). In other words, it was a non-sporiferous green fluorescent organism possessed of a single polar flagellum, or in some cases, perhaps, provided with paired or triple polar flagella.

Smith attempted to follow Cohn's procedure in getting cultures of *Bact. termo* and succeeded, by inoculating Cohn's solution with water in which beans had been thrown, in securing a green fluorescent organism with a polar flagellum. He concludes that the morphologically similar non-fluorescent forms and the yellow bacteria should be included in this genus.

Vuillemin by an entirely distinct line of reasoning came to a similar conclusion. He notes that Ehrenberg based his generic description in part upon the type of cell motility, oscillatory. Today, he states, we know this characteristic type of motion to be due to the presence of polar flagella on short rods. He concludes that the *Bact. termo* is closely related to *Bacillus pyocyaneus* and accepts this as the type of the genus.

Still a third line of evidence will lead to a similar conclusion, i.e., a study of the species of *Bacterium* other than *Bact. termo* recognized by Cohn and his coworkers. Three species previously described were placed in the genus *Bacterium* by Schröeter. One of these was the *Vibrio syncyaneus* of Ehrenberg, the organism repeatedly described in literature as the cause of blue coloration in milk. It is a polar flagellate rod. The name *Bact. aeruginosum* is the earlier name applied by Schröter to the blue pus organism, chosen by Vuillemin to constitute the generic type. The organism termed *Bact. xanthinum*, however, belongs to an entirely distinct group.

It is evident therefore that there is historical justification for E. F. Smith's emendation of the genus. The principal criticism is the undue insistence upon motility. It would seem that an organism morphologically similar but non-motile, showing the same fluorescence and physiological characters should likewise be included in the genus.

Notwithstanding the force of the above arguments in favor of using the generic name *Bacterium* for this group, this use will lead to the greatest confusion in the literature. It would seem best to use the name *Pseudomonas* for this genus, designating *Bacterium* as a *genus conservandum* for the colon-typhoid group of bacteria in accordance with the proposal of Orla Jensen (1909a p. 343). This is the recommendation of the Committee on Classification of the Society of American Bacteriologists.

Genus 2. **Serratia** Bizio, 1823, emended

Synonyms:

Zaogalactina Sette, 1824, p. 51
Erythrobacillus. Fortineau, 1905, p. 104

Cells rod-shaped, without spores. Motile by means of peritrichous flagella or non-motile. Gram stain variable. Aerobic, producing a red or pink pigment, a lipochrome. Possibly closely related yellow and orange lipochrome-forming bacteria should be included here as well.

The type species is *Serratia marcescens* Bizio, the organism usually termed *Bacillus prodigiosus*. The synonomy of this organism is as follows:

Serratia marcescens Bizio, 1823
Zaogalactina imetropha Sette, 1824, p. 51
Monas prodigiosa Ehrenberg, 1848
Palmella prodigiosa Montagne, p. 727
Micrococcus prodigiosus Cohn, 1872a, p. 153
Bacillus prodigiosus Fluegge, 1886, p. 284
Bacillus imetrophus Trevisan, 1887
Bacillus marcescens De Toni and Trevisan, 1889, p. 976

Pfeiffer (1887, p. 46) lists *Serratia* under *Fungi dubiae sedis* and ascribes the genus to *Bergamaschi.*

Vuillemin (1913, p. 521) concluded that although the characters used by Bizio have no generic value, nevertheless the generic name might well be revived to include the rod-shaped bacteria with diffuse flagella. He terms *Serratia subtilis* (*Bacillus subtilis*) the type of his emended *genus conservandum.*

Genus 3. **Chromobacterium** Bergonzini, 1881, p. 153

Synonyms. The name was spelled *Cromobacterium* by Bergonzini, and corrected by Zimmerman (1881 p. 1528). The spelling *Chromobacterium* has been accepted by other writers. (Grove, 1884, p. 26; De Toni and Trevisan, 1889, p. 978).

Rod-shaped bacteria, without spores, aerobic, producing a violet chromoparous pigment soluble in alcohol but not in chloroform, motile or non-motile, Gram stain variable.

The type species is *Chromobacterium violaceum* Bergonzini.

Genus 4. **Pasteurella** Trevisan, 1887, p. 94

Synonyms:

Octopis? Trevisan, 1885, p. 102
Coccobacillus Gamaleia, 1888, p. 167
not *Coccobacillus* Leube, 1885
Dicoccia? Trevisan, 1889, p. 1034
Diplobacillus? Weichselbaum, 1887, p. 212

Short rods, single or rarely in chains, usually showing distinct polar staining, non-motile. Gram-negative, without spores, aerobic and facultative, usually not producing gas, powers of fermentation slight, often pathogenic, not acid-fast, not liquefying gelatin.

The type species is *Pasteurella choleraegallinarum* (Fluegge) Trevisan.

Genus 5. **Bacterium** Ehrenberg, 1828, emended, Jensen, 1909

Synonyms:

Actinobacter Duclaux, 1882, p. 110
Klebsiella Trevisan, 1885, p. 94
Kurthia? Trevisan, 1885, p. 92 in part
Pneumobacillus? Arloing, 1889, p. 428
Pyobacillus Koppanyi, 1907, p. 429
Aërobacter Beijerinck, 1900, p. 198
Salmonella Lignieres, 1900a, p. 389
Tyrothrix? Duclaux, 1879, in part?

Plump rods, without spores, Gram-negative, motile by means of peritrichous flagella, or non-motile, liquefying gelatin very slowly or not at all. Usually showing marked power to ferment carbohydrates, frequently with gas production.

The type species is *Bacterium coli* Escherich.

The genus is a large one, including many species. It is generally divided into subgroups based primarily upon the fermentative reactions. It may be convenient to recognize these as subgenera separated from each other by the characteristics noted in the following key:

Key to the subgenera of Bacterium

A. Organisms which show a maximum of fermentative power, including fermentation of lactose, rarely pathogenic, some forms slowly liquefy gelatin. Subgenus 1. *Aërobacter* (*or Eu-Bacterium*).

B. Organisms not showing maximum fermentative power, never producing gas in lactose, frequently pathogenic, never liquefying gelatin.

1. Producing acid and gas from glucose, sometimes other sugars, but not from lactose.....Subgenus 2. *Salmonella*
2. Producing gas from none of the carbohydrates, acid sometimes formed.....Subgenus 3. *Eberthella*

Subgenus 1. **Aërobacter** Beijerinck, 1900, p. 198

Fermenting both glucose and lactose with formation of both acid and gas. Pathogenicity slight.

Type species is *Bacterium* (*Aerobacter*) *coli* Escherich.

Subgenus 2. **Salmonella,** Lignicres,

Fermenting glucose but not lactose with formation of acid and gas. Frequently pathogenic.

The type species is *Bacterium* (*Salmonella*) *cholerae suis*?

Subgenus 3. **Eberthella** subgen. nov.

Not producing gas from any of the carbohydrates, acid may or may not be formed.

The type species is *Bacterium* (*Eberthella*) *typhi*. Flügge.

Genus 6. **Proteus** Hauser, 1885, p. 1

Synonyms:

Liquidobacterium Jensen, 1909a, p. 337
Spirulina Hueppe, 1886, p. 146
not *Spirulina*, Turpin, 1827

Short rods, showing great variation in morphology, filamentous and bent rods as involution forms frequent. Motile by means of peritrichous flagella. The species commonly produce motile "islands" on the surface of moist solid media. No spores. Gram-negative. Usually liquefying gelatin rapidly in absence of carbohydrates. Usually producing acid and gas from certain carbohydrates. In general the species are closely associated with decay and putrefaction, sometimes pathogenic.

The type species is *Proteus vulgaris* Hauser.

Genus 7. **Pfeifferella** gen. nov.

Non-motile rods, slender, Gram-negative, without spores, staining poorly, sometimes forming threads and showing a tendency toward branching. Gelatin may be slowly liquefied. Do not ferment carbohydrates. Growth on potato characteristically honey-like.

The type species is the glanders bacillus, *Pfeifferella mallei.*

Genus 8. **Lactobacillus** Beijerinck, 1901, p. 214

Synonyms:

Lactobacter Beijerinck
Brachybacterium Troili Petersson, 1903, p. 138 in part
Caseobacterium Jensen, 1909a, p. 478
Dispora? Kern, 1882a, p. 135
Tyrothrix? Duclaux, 1882, in part

Rod-shaped organisms, cells frequently quite elongate, non-motile, without spores, Gram-positive in young cultures. Produce acid, largely lactic, from carbohydrates. When gas is produced, it is CO_2 without hydrogen. For the most part the organisms are thermophilic. Microaërophilic.

The type species is *Lactobacillus caucasicus* (*Kern*) *Beijerinck.*

Genus 9. **Erysipelothrix** Rosenbach, 1909, p. 367

Rod-shaped organisms with a tendency to the formation of long filaments which may show branching. The filaments may also thicken and show characteristic granules. No spores. Non-motile. Gram-positive. Does not produce acid. Microaërophilic. Usually parasitic.

The type species is *Erysipelothrix rhusicpathiae* (*E. porci*), the causal organism of swine erysipelas.

Genus 10. **Corynebacterium** Lehmann and Neumann, 1896

Synonyms:

Corynemonas Jensen, 1909, p. 22
Corynethrix Bongert, 1901, p. 449

Rods which stain interruptedly (striped) with weak staining solutions. Not acid-fast. Clubbed, wedge-shaped and pointed rods frequent. Gram-positive. Non-motile. No spores. Aërobic.

The type of the genus is *Corynebacterium diphtheriae* Lehmann and Neumann.

Tribe III. **Mycobacterieae** Trib. *nov.*

Synonyms:

Coccothrichaceen Lutz, 1886, p. 22
Mycobacteriaceae Chester, 1897, p. 62 in part

Rod-shaped organisms occasionally showing a tendency to branching, acid-fast, Gram-positive, non-motile, without spores.

A single genus is included, *Mycobacterium* Lehmann and Neumann.

Genus 1. **Mycobacterium** Lehmann and Neumann, 1896, p. 363

Synonyms:

Coccothrix Lutz 1886, p. 22
Sclerothrix Metschnikoff, 1888, p. 70
not *Sclerothrix* Kuetzing, 1849, p. 319

Slender rods which stain with difficulty, but when once stained, are acid-fast. Clubbed, swollen, clavate or cuneate cells occur, even filaments with branches. Non-motile. Without spores. Gram-positive.

The type species is *Mycobacterium tuberculosis* (Koch) Lehmann and Neumann.

Vuillemin (1913 p. 527) contends that *Coccothrix* resembles too closely *Coccotrichum* Wallroth. It does not seem that the resemblance is close enough ever to cause confusion, and the genus name *Coccothrix* is apparently valid. The Committee on Classification of the Society of American Bacteriologists, however, has recommended the use of the generic name *Mycobacterium* as better known and less likely to result in confusion.

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